DOCUMENT RESUME

ED 122 585 FL 006 666

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TITLE The Bilingual's Lexical Store. Working Papers on Bilingualism, No. 1.
INSTITUTION Ontario Inst. for Studies in Education, Toronto. Bilingual Education Project.
PUB DATE Nov 73
NOTE 32p.; For related documents, see FL 006 664, FL 006 667 and FL 006 668

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Aural Stimuli; *Bilingualism; Bilingual Students; *Cognitive Processes; College Students; Decoding (Reading); English; French; *Language Research; Language Usage; Phonology; *Psycholinguistics; Reading Processes; Sentence Structure; Syntax; Visual Stimuli; *Vocabulary
IDENTIFIERS *Code Switching; Language Processing

ABSTRACT

Forty bilingual Ss were tested in four experiments to see if decoding of linguistically mixed texts with one-word substitutions in the other language would take more time than decoding of unilingual material. The overall aim was to further explore the nature of the language switch mechanism as it functions in input. In the first experiment, consisting of two unilingual and three bilingual sets of sentences, presented visually, Ss had to judge the trueness or falsehood of each statement. In the second study, Ss read unilingual and bilingual passages where reading times were compared. In the third experiment, patterned after Experiment I, Ss heard and judged the trueness or falsehood of forty sentences with randomly placed lexical substitutions. In the final study, the one-word substitutions, previously randomized, were placed at subject, then verb, phrase boundaries. Conclusions were that: (1) in input, switching occurs when more than one word is substituted, and this switching is primarily at the phonological and syntactic levels; (2) the switch mechanism operates mainly in output where mixing of both languages is deliberate; and (3) the bilingual possesses not two but one basic internal dictionary where words in both languages are pooled. (Author/CLK)

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ABSTRACT

THE BILINGUAL'S LEXICAL STORE

Gerald G. Neufeld

Forty bilingual Ss were tested in four experiments to see if decoding of linguistically mixed texts with one-word substitutions in the other language would take more time than decoding of unilingual material. The overall aim was to further explore the nature of the language switch mechanism as it functions in input. In the first experiment, consisting of two unilingual and three bilingual sets of sentences, presented visually, Ss had to judge the trueness or falsehood of each statement. The time needed by Ss to decode unilingual sentences in both of their languages was compared with the time they took to decode bilingual blocks of sentences. No switching time whatsoever was detected in this experiment. In the second study, Ss read unilingual and bilingual passages where reading times were compared. With texts in L_1 word order with L_2 lexical substitutions, no switching time was found. Passages in L_2 order with L_1 substitutions, however, took longer to read than predicted; the additional time here was attributed to different reading strategies for L_1 and L_2. Ss also exceeded expected times in the third experiment where they heard and judged the trueness or falsehood of forty sentences with randomly placed lexical substitutions, patterned after Experiment I. In the final study, the one-word substitutions, previously randomized, were placed at subject then verb phrase boundaries. Also, considerable care was taken to eliminate all semantic ambiguity and anomaly. Under these conditions, Ss needed no additional time to decode mixed material according to the analyses.

Conclusions were: 1) that in input, switching occurs when more than one word is substituted, and that this switching is primarily at the phonological and syntactic levels; 2) that the switch mechanism operates mainly in output where mixing of both languages is deliberate; and 3) that the bilingual possesses not two but one basic internal dictionary where words in both languages are pooled.

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THE BILINGUAL'S LEXICAL STORE

by Gerald G. Neufeld

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It is commonly thought that one who has become proficient in two languages possesses two linguistically independent systems, either of which can be used at will (Haugen, 1956; Weinreich, 1954; Lambert, Havelka and Gardner, 1959). Those sharing this point of view argue convincingly that were it otherwise, bilinguals would continuously mix up their languages when speaking, with the result that their monolingual interlocutors would grasp only fragments of their speech. For that matter, such speech would not likely be understood by anyone because of the random occurrence of the switches. For two acquired languages to be relatively independent of one another from the linguistic standpoint, they must likewise be psychologically distinct entities. They become psychologically autonomous when the bilingual can consistently select the appropriate sounds, words and grammatical rules when speaking either of his two languages. A more inclusive description of psychological independence would necessitate a lengthy discussion of the problem of meaning and how bilinguals manage to maintain distinct semantic stores for their two linguistic systems, if indeed they do. Alluring as this issue is, I shall resist involving myself in its innumerable complexities for the moment and take the subject up again in my concluding remarks.

The concept of linguistic and psychological independence as set forth by Macnamara (1971) seems eminently sensible since bilinguals are normally able to keep their languages distinct from one another. To remain in one language without serious interference from the other they would need a mechanism of some kind which, in some ways at least, might be analagous to a conventional railroad switch. The aim of this paper is not to question the validity of the switch or

independence hypothesis but rather to further explore the nature of this switch or mechanism, what it consists of and under what conditions it operates.

Paul Kolers in a series of studies published in 1966 found that bilinguals took more time to read linguistically mixed passages (texts written in both French and English) than they took to read comparable passages in either language. From this he deduced that the additional seconds required to decode bilingual passages represented switching time. To go from one language to the other, Kolers found that Ss took an average of .40 seconds for each switch. John Macnamara, in another series of studies examining the input switch or decoding side only, corroborated Kolers' results. He discovered that with visually, then auditorily presented sentences, in unilingual and mixed conditions, bilinguals consistently required more time to comprehend statements written in both languages. His analyses yielded an average switching time of .20 seconds. Although neither Kolers nor Macnamara was specific on this point, their results and interpretations imply that the language switch mechanism is a multilayer device which operates at the phonetic, phonological, lexical, syntactic and semantic levels. The hypothesis suggests that all levels, while independent of one another, function in tandem, that is, that when an anglophone bilingual hears a series of French phonemes, his switch mechanism automatically shunts the input to the appropriate lexicon and set of grammatical rules for that language. Although this may normally be the case, particularly with respect to the input switch, a number of casual observations of bilingual behavior lead me to suspect that, under certain conditions, the switch may operate only partially. This is to say that not all of the linguistic levels alluded to earlier are necessarily triggered in every switching situation.

Beginning with the output segment (encoding side) of Macnamara's two-

switch model, (1967) it is clear that, not only can bilinguals choose at will the language they wish to speak, but they are also able to voluntarily make use of from one to all of the normal operations of the switch. An illustration of this ability is where a French language teacher addresses his anglophone pupils, reproaching them for their scanty knowledge of grammar and poor articulation habits. To demonstrate the notable differences between his speech and their's, he begins by speaking impeccable French with attention to style and articulation. He then underscores his point about their grossly inadequate command of the grammatical rules of French by mapping his knowledge of English syntax onto his otherwise standard French. He concludes with speech which, while lexically French, resembles English in every other way. Here the teacher is deliberately and systematically defeating various operations of the switch mechanism.

Another instance of the partial operation of the switch, again in the output mode, is the occasional "slip of the tongue" where a word in the second language (hereafter referred to as L_2) is inserted in a statement in the first language (or L_1). Here we must distinguish between predictable interference phenomena and the infrequent accidental insertion of a foreign word in spontaneous speech. Words which are commonly interchanged such as "weekend" in French or "rendez-vous" in English do not qualify as lexical switches, at least for our purposes. Similarly, the francophone automobile mechanic in Quebec who allegedly speaks no English and who habitually uses the word "bumper" in place of "pare-chocs" in his technical discussions cannot be said to be switching languages. His use of the word "bumper", although it may sound English in nearly every respect, is only one more illustration of the well-known fact that one can easily incorporate a foreign word into

one's own lexicon without significantly altering its pronunciation. The situation I wish to refer to here, unlike the example of the French teacher, where switching at various levels was entirely voluntary, often goes unnoticed, expecially if the listener happens also to be a bilingual from the same region. Anyone who has learned a second language and uses it frequently will recall situations where a word in L_2, usually monosyllabic, somehow slipped in while speaking L_1. It is extremely difficult to study such phenomena because of their utterly spontaneous and unpredictable nature, to say nothing of their relatively low frequency. From what I've been able to gather, such occurrences are accidental and they do not appear to be phonologically or syntactically conditioned. One of the more interesting aspects is that, despite the unmistakable foreignness of the substituted word, it has always been phonetically L_1 in every case I have noted. In other words the appropriate set of phonetic rules for the inserted foreign word does not appear to be observed in such cases, i.e. no switching at the phonetic level. This phenomenon is the more remarkable in that there are no detectable non-prosodic pauses before or after the foreign word; the speaker often continues talking, completely oblivious of the error he has made. One might explain the English-sounding foreign word as simply the result of inadequate time for the articulatory muscles to re-adapt themselves to the production of French sounds. Since these unintentional substitutions seem to occur randomly from a syntactic standpoint and inasmuch as there appear to be no semantic factors influencing their incidence, it is reasonable to assume that the triggering stimulus in such cases has its origin in the organism itself rather than in the environment.

Another situation where the switch operates at only some linguistic levels, resulting in foreign-sounding speech, will be instantly recognized

by anyone who became bilingual as an adolescent or an adult. In situations of stress or mental fatigue, one often finds oneself, when speaking L_2, to be "back-sliding" as it is often termed, (Selinker, 1972) toward the sounds and syntax of L_1. Sometimes this involuntary and frequently unnoticed deviation is only momentary, involving no more than one or two words and occasionally only parts of a word.

From all of this we can be sure of at least two things; first, that bilinguals are able to switch languages with relative ease without serious interference problems, and second, that the switch mechanism itself is a highly complex device which functions in a variety of modes and configurations. Furthermore, it is conceivable that with single lexical substitutions of the type described above, no switching whatsoever occurs despite all appearances to the contrary. Stated another way, internalized concepts with their French and/or English tags are pooled irrespective of the language by means of which they may have been acquired. This idea will be considered in greater detail later on in this paper. To further test the switch hypothesis against the no-switch hypothesis for single lexical substitutions, four experiments were conducted with French and English bilingual students at the University of Ottawa. Some of the materials, many of the ideas and most of the design for three of these four studies came from numerous enlightening discussions with Professor John Macnamara of McGill University who had recently completed a similar project. Those familiar with his work in this area will note that while our basic experimental approach is very similar, our working hypotheses are less so.

EXPERIMENT I

Scope

The first experiment sought to determine if bilingual Ss would require more time to decode a statement written in both of their languages than they would for comparable statements written in either L_1 or L_2. To test comprehension, Ss were instructed to declare whether each statement was true or false. Linguistically mixed sentences had either one, two or three possible switching situations; each switch, according to Kolers and Macnamara, should significantly add to the time needed to unravel the statements. In the sentence, "The girl parle to her friend", the switch mechanism would, in theory, be triggered at least twice around the word "parle", and possibly a third time if the last word in the preceding sentence was in French.

Subjects

To minimize problems in the interpretation of data resulting from varying proficiency levels in L_2, considerable care was taken in the selection of the Ss for this project. Forty balanced bilinguals, twenty anglophones and twenty francophones were chosen for the four studies according to three criteria. By balanced is meant here the ability to go from one language to the other with ease in a variety of formal and informal situations. Fifty-four persons known by E and the project assistant to be fluent bilinguals were contacted. Each completed a detailed self-report type questionnaire, available in French and English, containing items about their linguistic background and current proficiency level in the second language. Individuals who professed to have little experience in reading L_2 were considered undesirable because of the visual aspect of several of the studies. The third

criterion was a listening comprehension test where Ss were asked to determine the trueness or falsehood of forty tape-recorded statements in either French or English which were presented in one of five random order blocks. Sentences ranged from simple to compound-complex with numerous semantically involved statements. No attempt was made to abridge the vocabulary. Those making more than five percent errors in this test were disqualified. Nearly all of the forty Ss who participated in the studies described here were students enrolled at the University of Ottawa, which is a bilingual institution offering instruction in English and French. The mean ages and standard deviations (shown in parentheses) of the two groups of twenty Ss each were 24.2 (3.6) and 23.9 (3.5).

Materials

A complete inventory of the vocabulary and idiomatic expressions appearing in the auditory and visual stimuli for the four experiments was made, from which were compiled two lists, one in English and one in French. Each list which contained nearly three hundred words, served as a means of verifying Ss' knowledge of the vocabulary they were to encounter.

For the first experiment, the fifty unilingual and bilingual sentences used by Macnamara in his 1969 study were used. The sentences were divided into five blocks with ten in each as follows: 1. Ten unilingual English sentences; 2. Ten unilingual French sentences; 3. Five primarily English sentences and five primarily French sentences with one switching situation in each; 4. Five primarily English sentences and five primarily French sentences with two switching situations in each; 5. Five primarily English sentences and five primarily French sentences with three switching situations in each. (See Appendix for examples) Lexical

substitutions were placed randomly with the constraint that not more than three in one language appeared consecutively. Each statement was six syllables in length with a restricted vocabulary drawn from forty high frequency words in French and forty in English. All sentences were typed in large letters on an electric machine using a carbon ribbon and then photographed onto slides for projection with white letters on black background. This procedure differs slightly from Macnamara's where film strips were used. Six additional slides containing statements in English, French and both languages were prepared for illustration purposes. Sets of instructions in English and in French were tape-recorded and dubbed onto the first track of the simultaneous four-track system employed for the project.

Procedure

Each S, individually tested, carefully read the list of words and expressions for L_2. Whenever items appeared unfamiliar to an S, the monitor explained their meanings and usage. However, this was rarely necessary. Ss were then seated at a console and were supplied with close-fitting headphones designed to reduce extraneous noise to a minimum. They were asked in the pre-recorded instructions to read each sentence as it was presented to them and to depress the appropriate key the instant they knew whether the statement was true or false. For fifty percent of Ss the right key was used for marking true and the left for false, and in the remaining cases the reverse order was observed. Except for the six sample statements, blocks and sentences within them were randomized and counterbalanced across Ss. Sequencing was entirely automatic with one track of the four-track system employed to trigger the projector. Depression of either of the keys stopped an

electronic clock which permitted measurement to one-thousandth of a second. The clock was then automatically reset and activated at precisely the instant the next sentence appeared on the screen. The monitor had only to keep track of the time taken by each S to decode and judge each statement. Sentences were projected onto the screen for a period of eight seconds after which there was a lapse of .85 second before the appearance of the next slide.

To find out whether Ss needed more time to decode mixed sentences than unilingual ones, it was necessary to devise a theoretically sound means of measuring this time. It was impossible, of course, to simply test the significance of means based purely upon observed times for the five blocks, since individual variation in decoding time for English and French could not have been accounted for. After much consideration, Macnamara's approach was finally adopted. It consists essentially of subtracting the time each S was predicted to take for a bilingual sentence from the time he actually took. These differences were then summed and divided by the number of sentences in the block, ten in this case, which yielded an average switch time for the S for a given block of statements. The differences between the means for two and then three blocks were tested for significance. The condensed worksheet below will serve to clarify how expected times were derived.

FIGURE 1

Procedures for Predicting Time Required to Decode and Judge a Bilingual Sentence

Data for Subject 22, Series 1, Block 1:

Steps:

1. To derive per syllable decoding time for English sentences, divide total observed time taken for ten English unilingual sentences by S by total number of syllables in those sentences.
   22,020 ms. (milliseconds) ÷ 60 = 367 ms.

2. Follow same procedure for ten unilingual French sentences.
   25,260 ms. ÷ 60 = 421 ms.

3. To obtain expected decoding time for each sentence, multiply number of English syllables in that sentence times observed per syllable time in English; multiply number of French syllables in sentence times observed per syllable time in French and sum the two.
   Eg.: Block 3 - One switch sentences:
   Expected Values - Sentences 21 - 30:

Calculations				Expected Times
(3 x 367 ms.)	+	(3 x 421 ms.)	=	2364 ms.
(5 x 367 ms.)	+	(1 x 421 ms.)	=	2256 ms.
(2 x 367 ms.)	+	(4 x 421 ms.)	=	2418 ms.
(1 x 367 ms.)	+	(5 x 421 ms.)	=	2472 ms.
(4 x 367 ms.)	+	(2 x 421 ms.)	=	2310 ms.
(1 x 367 ms.)	+	(5 x 421 ms.)	=	2472 ms.
(2 x 367 ms.)	+	(4 x 421 ms.)	=	2418 ms.
(4 x 367 ms.)	+	(2 x 421 ms.)	=	2310 ms.
(1 x 367 ms.)	+	(5 x 421 ms.)	=	2472 ms.
(5 x 367 ms.)	+	(1 x 421 ms.)	=	2256 ms.

4. To obtain S's switch time per sentence, subtract expected value from observed value.

5. To obtain S's average switch time per bilingual block, calculate mean of the differences.
   Eg.: Switch Times and Means - Sentences 21 - 30:

Observed Value		Expected Value		Switch Time	Mean
2571 ms.	-	2364 ms.	=	207 ms.	20.7 ms.
2339 ms.	-	2256 ms.	=	83 ms.	8.3 ms.
2420 ms.	-	2418 ms.	=	2 ms.	0.2 ms
1973 ms.	-	2472 ms.	=	-499 ms.	-49.9 ms.
2024 ms.	-	2310 ms.	=	-286 ms.	-28.6 ms.
3084 ms.	-	2472 ms.	=	612 ms.	61.2 ms.
2006 ms.	-	2418 ms.	=	-412 ms.	-41.2 ms.
2440 ms.	-	2310 ms.	=	130 ms.	13.0 ms.
2005 ms.	-	2472 ms.	=	-467 ms.	-46.7 ms.
2549 ms.	-	2256 ms.	=	293 ms.	29.3 ms.

Results and Discussion

In the following table are listed average observed times taken by Ss to complete blocks one through five along with their standard deviations which appear in parentheses. Average switch times for the bilingual blocks 3, 4 and 5 are also included.

TABLE 1

Means and Standard Deviations for Observed Times
for Blocks 1 through 5
Average Switch Times for Blocks 3, 4 and 5.

Block 1: Unilingual English sentences

Block 2: Unilingual French sentences

Block 3: Bilingual sentences with 1 switching situation

Block 4: Bilingual sentences with 2 switching situations

Block 5: Bilingual sentences with 3 switching situations

	Block 1	Block 2	Block 3	Block 4	Block 5
English Ss':					
Means	1930ms.	2012ms.	1957ms.	1903ms.	1955ms.
S.D.'s	(203)	(93)	(228)	(134)	(76)
French Ss':					
Means	2300ms.	1900ms.	1920ms.	1981ms.	1987ms.
S.D.'s	(200)	(227)	(129)	(302)	(83)
Average switch times (pooled):			-433ms.	-425ms.	-175ms.

Macnamara's results and those obtained here differ considerably. They are comparable only with respect to three rather minor points. In both instances, Ss took more time to decode statements in L_2, as might be expected. Furthermore, anglophone and francophone bilinguals in the two experiments took approximately the same amount of time - nearly two seconds - to decode and judge the trueness or falsehood of the statements in blocks 1, 2 and 3. In

sharp contrast, however, are the times taken by Macnamara's and E's groups to decode the bilingual blocks. Where Macnamara's Ss needed more time in the mixed conditions than for any of the unilingual ones, many of the bilinguals in the present study appeared to have experienced little or no inhibiting effects when reading and interpreting sentences written in both languages. If switching actually took place and if the process required time, as one would expect, analyses of the type described earlier did not reveal it. Ss took significantly less time than predicted by calculation to decode and judge bilingual statements, $t(39) = 10.93$, $p < .001$. Anglophones and francophones did not differ significantly here, $F(1,39) = 1.82$, $p > .05$. For block 4, which consisted of ten statements with two switches in each, the situation was much the same, $t(39) = 9.77$, $p < .001$. As before, no significant differences between the means for English- and French-speaking Ss was detected, $F(1,39) = 1.52$, $p > .05$. Even in the fifth block, where there were three switches per sentence, means were less than those predicted, $t(39) = 3.23$, $p < .05$. Here too, no differences were found between the two groups of Ss, $F(1,39) = 1.35$, $p > .05$.

The absence of switching time in the three bilingual blocks is puzzling in light of Macnamara's data. The discrepancies between the studies may lie with the careful controls employed here for proficiency level in L_2. Ss who are either unaccustomed to reading in the second language or who are only marginally bilingual might be expected to experience more difficulty than "balanced bilinguals" with information retrieval when using L_2. The fact that the vocabulary for this experiment was highly restricted says little, of course, about how frequently Ss actually used these words in everyday contexts. In other words, the additional time observed by Macnamara needed to decode linguistically mixed sentences, may have had relatively little to

do with the operation of the switch mechanism. Presented with sentences like "The horseback riders began their trip at dawn" and "The equestrians commenced their trek at dawn", most anglophones, when asked to decide whether such statements were reasonable or not, would probably take more time to respond to the second sentence. The delay would not be due to increased syntactic and semantic complexity or ambiguity, but simply to the problem of dealing with somewhat uncommon words.

Significant as the proficiency level factor may have been, our highly bilingual Ss might still have been expected to require increasingly more time to judge statements as the number of L_1 or L_2 switching situations was augmented, provided, of course, that the input switch was indeed operating. Assuming for the moment that it was, it is plausible that the time needed for its operation could not be measured in an experiment like this where decisions requiring only milliseconds or perhaps even microseconds were involved. With just one-word substitutions, there is good reason to believe that if the switch was operating at all, its activity was restricted to the lexical level, and hence only partially functioning. Had Ss thought that correct interpretation of the statements depended upon subtle semantic distinctions between equivalents such as "cooking" and "cuisine", and had they been conditioned to expect lengthy series of substituted words, the time to go from one language to the other and back again might well have been greater and thus measurable.

Another possibility is that, on the input side, single lexical substitutions as used in these experiments are not sufficient in themselves to trigger any level of the switch mechanism, particularly where no disruption of syntax is involved. "Chante", for example, in "The boy chante very well", occupies the same slot as "sings" and accordingly requires no switching of syntactic

rules. "Rien was eaten by the boy that day", on the other hand, might cause Ss, when reading to hesitate momentarily in search of the missing element of the negative construction normally used with "rien". This problem of violation of syntax was difficult to circumvent because of the random placement of the substituted words; as it happened, there were fortunately few such instances. From the semantic standpoint, it is unlikely that any of the forty words in French or English caused problems of interpretation. Had most of our Ss learned L_2 in distinctly different cultural settings from their own, it is conceivable that even with the limited vocabulary used here, there might have been some connotative difficulties. Such was not the case, however. On the phonological level as well, no evidence of switching was suggested by the data. English-speaking readers encountering the sentence "The rendez-vous was at six o'clock" clearly have no phonological decisions to make about the Englishness or Frenchness of the word "rendez-vous". With words or expressions which cannot properly be considered as borrowings, however, the situation is less certain. In "The chien ate quickly", most would intuitively argue that, to get beyond the word "chien", the reader would have to decide which of his two languages this word belonged to. Such a decision, it seems, would require time. As already stated, no additional time was detected. Perhaps Ss looked at all lexical substitutions in L_2 as part of their basic lexicon much in the way anglophones would approach the word "rendez-vous" and hence had neither phonological nor lexical decisions to make. More will be said about this later.

EXPERIMENT II

Scope

To determine whether the presentation of sentences in isolation, that is with no semantic context, might have been a significant factor influencing Ss' performance in Experiment I, the original materials were replaced with more lengthy passages. It was hoped that some insight might be gained about the reading strategies employed by bilinguals for L_1 and L_2, although there was no attempt to formally study this problem.

Materials

Four passages, each two hundred syllables in length, were prepared. One was in English only, another in French and the third and fourth in both languages. The bilingual passages were either in French or English word order, with thirty-three one-word substitutions in L_2 randomly placed throughout the texts. (See Appendix for examples) Unlike the sentences in the first experiment, the vocabulary was in no way abridged. The intent was to provide reading materials which were both interesting and uncontrived. Since it was desirable to avoid syntactic and semantic disparity between the French and English unilingual and bilingual paragraphs, all passages were selected from the well-known novel L'Etranger by Albert Camus, for which excellent and fairly literal translations were available. Each passage was typed and then photographed onto slides in the manner already described. The original texts were modified slightly in order to obtain uniformity in length.

Procedure

Ss were told in the pre-recorded instructions that they would see four passages, two of which would be bilingual. The moment each paragraph appeared on the screen, the electronic timer was activated; it was stopped when Ss depressed the appropriate key. To maintain continuity, it was not possible to test Ss' comprehension of every statement in the text as it was read. It would have been feasible to check how much they had understood in general, although this was not done since reading times for each of the four paragraphs was the primary objective. The methods used to ascertain whether mixed passages took longer or not to read are already familiar to the reader.

Results and Discussion

As can be seen in Table 2 below, Ss reading the passages in L_1 word order with L_2 substitutions took less time than anticipated to finish the paragraph, for anglophones, $t(19) = 5.09$, $p < .001$, and for francophones, $t(19) = 8.13$, $p < .001$. The differences between the two groups were significant, $F(1,39) = 4.10$, $p < .001$. Paragraphs in L_2 word order with subsitutions in L_1, however, required more time to read than predicted, $t(39) = 5.98$, $p < .001$. The means for the two groups were not significantly different, $F(1,39) = 1.21$, $p > .05$. As was the case in the first experiment, Ss needed more time to read materials in their second language.

TABLE 2

Observed per Syllable Times for Unilingual Passages
along with
Calculated Switching Time for Bilingual Passages

	Per Syllable Time in		Switching Time for	
	L_1	L_2	L_1 order	L_2 order
English Ss':				
Means	192.65ms.	218.65ms.	-50.00ms.	13.20ms.
S.D.'s	(58.29)	(39.85)	(43.91)	(24.80)
French Ss':				
Means	156.90ms.	200.79ms.	-39.45ms.	36.20ms.
S.D.'s	(39.10)	(44.01)	(21.68)	(22.56)

Even with continuous discourse, Ss had no appreciable difficulty decoding bilingual passages where most of the text was in their first language. Because of the lack of information about general comprehension by Ss of the materials presented to them, the results of the tests used in this experiment are somewhat less conclusive than those of the first. The spontaneous reactions of both French and English groups left little doubt about their motivation and interest, however. Many immediately recognized the material and were genuinely amused by some of the statements and allusions appearing in the excerpts. Assuming then that the paragraphs were read for comprehension and with interest, Ss clearly demonstrated their ability to more easily process information in L_2 where L_2 words were interpolated into essentially L_1 texts. This pointed strongly to the tentative conclusion formed after analyses of the first study that one-word substitutions in L_2 were by and large seen by Ss as belonging to L_1, with the effect of completely bypassing the switch mechanism.

The fact that both French- and English-speaking Ss required more time than expected to handle the material in L_2 word order suggests that, when

reading in the weaker language, Ss were somewhat disturbed by the random lexical substitutions in L_1, and that this break in continuity prompted them to switch to their stronger language when encountering an L_1 substitution. It is not impossible that, when reading in L_2, bilinguals are less willing to consider substituted words in their first language as belonging to L_2. Still another possibility which merits further study is that bilinguals, accustomed to reading in L_1, rely heavily upon their ability to guess the meaning of a statement before they finish reading it, in which case syntax would be used primarily as a back-up system. (Lyons and Wales, 1966; Reid, 1972) Visual scanning, then, would not necessarily include every word in the sentence. Proceeding in this manner, Ss might easily have skipped over a significant number of the randomly placed substitutions which would, of course, account in part for the lack of observed switch time. This ability to make and to test semantic hypotheses while reading, one might assume, would be hampered to a large extent when scanning material in L_2. This is to say that bilinguals, given only fragments of a sentence in L_2, would probably find it more difficult to fill in the blanks in their weaker language. Accordingly, syntax would assume a much greater role in the decoding of written material. As a result, any disruption whatsoever in continuity caused by substituting words in L_1, strange construction, quaint vocabulary, and so on would have the effect of slowing down the processing of information.

EXPERIMENT III

Scope

In addition to the strong possibility that bilinguals employ different reading strategies for their two languages, there is the problem of

self-pacing when reading which, needless to say, is not present when listening to actual speech. Furthermore, there is ample reason to suspect that the phonological component of the postulated switch is less active when processing information presented visually. (Kolers, 1966). These considerations were supplemented by the fact that all Ss participating in this study, although classified as fluent bilinguals, professed to have more contact with a spoken than with a written form of the second language. The third experiment, then, was to provide yet another means of determining the validity of the switch hypothesis.

Materials

Forty six-syllable sentences were prepared consisting of four blocks with ten sentences in each. Their configuration was patterned after blocks 1 through 4 of Experiment I. (See Appendix for examples) As in the preceding study, vocabulary and structure represented normal usage for both languages. All switches were randomly located with the constraint that not more than three occur consecutively.

Preparation of bilingual statements in written form presented relatively few mechanical difficulties. Accomplishing the random placement of one-word substitutions in tape-recorded sentences, however, required many hours of painstaking and frustrating work. To avoid phonological interference and undesirable hesitations, which almost always result when switching rapidly from one language to another, Macnamara made separate unilingual recordings in French and in English of each of the statements in his study involving auditory stimuli. These recordings were then edited and spliced in a manner which reproduced interference-free speech (Macnamara, 1971). Similar efforts by E with the best and most up-to-date equipment were only marginally success-

ful. It proved virtually impossible to eradicate many of the silent pauses which resulted from manual dubbing of texts. The approach which was finally adopted was cumbersome but functional.

The bilingual whose speech was used for the experiment first tape recorded all French versions of the twenty statements which were later to be mixed with English; the second tape contained the English versions of these statements. He then practised reading each sentence bilingually with its appropriate lexical substitution or substitutions. After eleven attempts, the master recording was played to several native speakers of English and/or French who commented on the naturalness of the speech. Numerous corrections had to be made. The third trial was accepted by the judges as being almost free of mechanical noise and undesirable interference. The approach was apparently successful, for there were only two comments by Ss who remarked that several of the words they heard seemed somehow unnatural. Except for these observations, the recordings were received without comment.

Procedure

The task in this experiment paralleled that of Experiment I with the important difference that Ss responded to auditory stimuli. Once again, sequencing was entirely automatic with eight-second pauses between each of the forty statements. The four blocks, as before, were counterbalanced across subjects.

Results and Discussion

The data in Table 3 resemble closely the results reported by Macnamara. Analyses yielded an average switching time of .32 seconds for sentences with one switch, $t(39) = 11.50$, $p < .001$. The means for the francophone and

anglophone groups were not significantly different, $F(1,39) = 1.28$, $p > .05$. In the block with two randomly placed switches, Ss exceeded expected times by an average of .48 seconds per sentence, $t(39) = 9.53$, $p < .001$. Again, no significant differences between the means for the two groups were found, $F(1,39) = 2.90$, $p > .05$. Times for decoding statements with two switches were significantly greater than those with only one switch in each, $t(39) = 6.46$, $p < .001$.

TABLE 3

Observed per Syllable Times for Unilingual Passages
along with
Calculated Switching Time for Bilingual Passages

	Per Syllable Time		Switching Time with	
	L_1	L_2	One switch	Two switches
English Ss':				
Means	87.60ms.	115.15ms.	295.60ms.	480.85ms.
S.D.'s	(30.42)	(47.73)	(172.91)	(368.83)
French Ss':				
Means	93.05ms.	111.45ms.	388.95ms.	472.55ms.
S.D.'s	(24.97)	(45.88)	(195.53)	(258.17)

It appeared that going from one language to the other and back again accounted for the increase in time taken by Ss to decode and judge the linguistically mixed statements. As shown in the table, times exceeding the expected values nearly doubled with the introduction of the second substitution. Since Ss could not adjust the rate of the input and inasmuch as they were forced to proceed linearly through the material, the switch hypothesis seemed a likely explanation. If, as postulated earlier, conditions exist where bilinguals tend to look at one-word substitutions in L_2 as part of their basic lexicon in L_1, why then would this not occur with auditory input? One possibility is that, when reminded in some way of the linguistic

differences between the two languages being used, Ss might be prompted to involuntarily switch from one language to the other. The sharp contrast between the sounds of English and French could hardly be missed when listening to bilingually recorded statements. Needless to say, these phonological cues are not present when reading. It is also possible that obligatory linear scanning in the visual or auditory mode, assures that every word, including substitutions, will be encountered. In line with the switch hypothesis, this would force Ss to switch at the appropriate points. The idea precludes, of course, a common lexical store. Another explanation is that the extra time attributed to the operation of the switch mechanism was due to factors other than alternation between L_1 and L_2. The fourth experiment was an attempt to further explore this possibility.

EXPERIMENT IV

Scope

Following Experiment III, the unilingual and bilingual tape-recorded statements were re-examined because of some problems which had arisen during the study. The first difficulty was that some Ss claimed that neither absolutely true nor absolutely false could be given as answers for some of the items in the test. The second and more troublesome matter was the syntactic disruption caused by the random placement of lexical substitutions. It appeared in retrospect that our compromise between syntactic continuity and semantic clarity had created conditions which might have significantly influenced Ss' performance. Along with these considerations, there remained the question of why switching time should appear only with auditorily presented material.

Like the preceding study, the fourth experiment was designed to measure bilinguals' ability to handle linguistically mixed texts. To avoid the problem of syntactic discontinuity, substitute words were placed at phrase boundaries rather than located randomly as before. Another precaution was to check and re-check for any signs of semantic ambiguity and anomaly in the statements. Apart from these modifications, the experiment differed little from the third study.

Materials

Forty sentences, again six syllables in length, were prepared. The first bilingual block consisted of ten statements - five basically in English and five basically in French - where one-word substitutions were inserted in the subject slot. The location of the subject in these sentences was varied as much as normal usage would allow. In the second bilingual block, substitutions were inserted in the verb slot where, again, the location was shifted for each sentence to the extent that statements did not appear syntactically bizarre. (See Appendix for examples) Four randomly ordered versions of each block were prepared and used as in Experiments I and III. Recording techniques were those employed for Experiment III.

Procedure

The forty Ss who participated in the earlier studies were re-contacted and scheduled for the final part of the project. The task was, as before, to declare whether the statements they heard were true or false and to depress the appropriate key the instant they knew the answer. The four blocks along with the versions of each were counterbalanced across subjects. The remaining details of the techniques and procedures are already known to

the reader.

Results and Discussion

The data in Table 4 below follow rather closely those in Table 2. With the one-word substitutions no longer violating syntax, and with semantic anomaly reduced to a minimum, the disparity in results between visually and auditorily presented materials all but disappeared. For the block containing substitutions in the subject slot, no switching time was detected in the analyses, $t(39) = 1.04$, $p > .05$. English- and French-speaking groups did not differ singificantly, $F(1,39) = 1.49$, $p > .05$. Nor did Ss appear to experience any difficulties with the block containing substitutions in the verb slot, $t(39) = .98$, $p > .05$. Differences between the two groups of Ss were not significant, $F(1,39) = 1.14$, $p > .05$.

The only switching which probably occurred here was at the beginning of statements where the language was different from the final word in the preceding sentence. Although, in theory, the switch could have been triggered up to twenty times in each bilingual block, it was probably activated only four or five times. It is doubtful that so few switches would have contributed sufficiently to the totals to show up as significant. It would seem from the data then that Ss make no distinction between L_1 and L_2 where single lexical substitutions are concerned. This is surprising since one would normally expect bilinguals to immediately react to the contrast between French and English sounds, and that this awareness would suffice to trigger the switching mechanism. If phonological decisions were necessary, the time required for them was not detected. It is conceivable that bilingual individuals may be prompted to accelerate the decoding process in order to make up for lost time when encountering linguistically mixed statements. Implicit in this

argument, of course, is that one is able to rapidly adjust decoding speed according to needs or circumstances. To serve as an explanation for the lack of observed switching time here, however, one would have to assume that this acceleration commenced with the appearance of the substituted word and ceased with the return to the original language of the statement. Although this may be the case, it seems unlikely in that one would more reasonably expect such acceleration to continue to at least the end of the sentence, with the result that Ss would have taken less time to decode the bilingual statements than they took to decode the unilingual ones. As shown in Table 4, this was not the case.

TABLE 4

Observed Times per Syllable for Unilingual Passages
along with
Calculated Switching Time for Bilingual Passages

	Per Syllable Time		Total Switching Time	
	L_1	L_2	(at subject)	(at verb)
English Ss':				
Means	74.20ms.	107.95ms.	-90.25ms.	9.45ms.
S.D.'s	(44.93)	(48.56)	(143.56)	(50.20)
French Ss':				
Means	92.50ms.	103.45ms.	34.20ms.	28.14ms.
S.D.'s	(45.00)	(58.54)	(175.12)	(65.93)

CONCLUDING REMARKS

If, as our data suggest, bilinguals tend to disregard the L_1-ness and L_2-ness of one-word substitutions as used in these experiments, there is ample reason to question the popular concept that an individual who knows two languages possesses a separate internalized dictionary for each language. (Van Willigen, 1964; Penfield, 1964) The accessing of information from two distinct stores would necessitate a switching device. The activation

of the switch in mid-sentence would surely result in some delay. With adequate training, bilinguals might eventually become quite adept at the mental gymnastics required for rapidly going from one language to the other and back again, even to a point where the time needed for these operations could not be accurately measured. The ease with which our uninitiated Ss performed these tasks, however, offers convincing evidence for the absence of such operations when in the input mode.

It follows then that the linguistic tags for concepts are stored, as are the concepts themselves, without regard to a specific language (Carroll, 1964; Hofmann, 1970). This is not to say that words, once learned, lose their language identity, for if they did, bilinguals would not be able to keep their languages lexically distinct in output. Stated another way, bilinguals or multilinguals have only one basic internal dictionary consisting of the lexical items they have learned for both or all of their languages. The pooled concept goes far to explain why our Ss encountered no appreciable difficulty with mixed texts since, with just one dictionary, no switching situations are involved.

Up to this point, discussion of the language switch mechanism has been confined to the input mode. Based on the findings here, some tentative conclusions about output are justified.

It is highly improbable that there exist separate lexical stores for decoding and encoding. Admittedly, one's passive vocabulary - on the input side - is substantially greater than what is available for spontaneous speech. This phenomenon is directly related to frequency of usage, however, and cannot be offered as proof for autonomous dictionaries. Kolers (1966) is undoubtedly correct when he asserts that mixing two languages when speaking or reading aloud takes additional time. In this case, decisions are clearly necessary about the Frenchness or Englishness of individual words, and about

the appropriate set of sounds needed for the articulation of each word. Although reading mixed passages aloud may suffice as a proof for the language switch mechanism, it does not establish anything about input or about the individuality of internalized lexicons.

Nor can the fact that bilinguals manage to keep their languages apart when speaking or writing be cited as evidence for the simultaneous functioning of all levels of the switch. Bilingual or not, speakers must continuously and rapidly make decisions about the probability of a given word being understood by their interlocutors. A university professor, for instance, accustomed to using elaborated codes with his colleagues, must carefully choose his words and phrasing when debating an issue with his four-year-old daughter. Testing the appropriateness of a term or structure for a given context is in many ways comparable to what the bilingual probably does when speaking in one of his two languages. In addition to the decisions he must make about what register to use, he must also accept or reject words, in French, English or whatever, which present themselves as expressing a concept he wishes to convey. How much time these multitudinous tests take is an open question. It would be interesting, for example, to study the spontaneous speech rate of monolinguals compared with that of bilinguals then multilinguals to see if these required decisions cumulatively slow down the production in L_1. However long these decisions take, they are not always efficient as evidenced by the occasional and accidental insertion of an L_2 word in an L_1 statement.

From these experiments, the operation of the switch mechanism would appear to be restricted in input to the phonological and syntactic levels in situations where strings of words rather than single lexical items are substituted. In output, however, its operation must be confined to somewhat

unusual circumstances, where, for whatever reason, mixing of the two languages would be desirable. In terms of linguistic theory, the results of these studies also support the view that the various levels, from phonetic to semantic, are not so indivisible as to make psycholinguistic study of each impossible.

APPENDIX

Examples of Bilingual Statements Used in Experiments I through IV

Experiment I: Examples taken from "The Linguistic Independence of Bilinguals" by John Macnamara, J. Verb. Learn. & Berb. Behav., 1971, 10, 482.

Block 3: Statements with One Switching Situation:
1) A monkey can drink eau.
2) Bien des hommes ont cinq eyes.

Block 4: Statements with Two Switching Situations:
1) Turnips sont vegetables.
2) Tous les souliers are noirs.

Block 5: 1) Every femme eats maisons.
2) Douze choses make une dozen.

Experiment II: Excerpts from Bilingual Paragraphs.

English Word Order with French Substitutions:
"...I did without bread as there wasn't any left, and I ne pouvais be bothered aller down to buy it. Après my lunch, I roamed autour the apartment..."

French Word Order with English Substitutions:
"Je me suis hissé à côté de her sur la bouée. Il was bon et comme en jest, j'ai laissé aller ma head en arrière et l'ai posée sur her ventre..."

Experiment III: Examples of Tape-recorded Bilingual Statements.

Block 3: Statements with One Switching Situation:
1) Rondes things are always square.
2) Les oiseaux ont deux wings.

Block 4: Statements with Two Switching Situations:
1) There are pas green apples.
2) Personne eats les dimanches.

Experiment IV: Examples of Tape-recorded Bilingual Statements with Substitutions at Subject then Verb.

Block 3: Substitution at Subject:
1) Les filles are always boys.
2) Young infants parlent très bien.

Block 4: 1) Watches never arrêtent.
2) Courir veut dire to run.

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